REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have cancelled claims 1, 2, 7 and 12-15, all of the claims considered on the merits in the Office Action mailed December 1, 2005, and are adding new claims 16-37 to the application. Of these newly added claims, claims 16 and 30 are independent claims, each reciting a polyester manufacturing apparatus which produces a high molecular weight polyester from raw materials of an aromatic dicarboxylic acid or its derivative and glycols. Claim 16 further recites that the apparatus includes first, second and third reactors, with the aromatic dicarboxylic acid or its derivative reacting with the glycols in the first reactor to form a first product, a polycondensation taking place in the second reactor thereby producing a second product which is a low molecular weight polyester polymerized to a higher degree than the first product produced in the first reactor, and a third reactor which further polycondenses the second product from the second reactor, thereby producing a high molecular weight polyester polymerized to a higher degree than the low molecular weight polyester. Claim 30 further recites that in the apparatus the aromatic dicarboxylic acid or its derivatives are reacted in a first reactor, forming a resulting first product, the first product being polycondensed in a second reactor to form a second product which is low molecular weight polyester, the second product being further polycondensed in a third reactor; and claim 30 recites that the apparatus includes this third reactor, with claim 30 reciting that this third reactor further polycondenses the second product to produce a high molecular weight polyester polymerized to a higher degree than the low molecular weight polyester formed in the second reactor.

Each of claims 16 and 30 further define the third reactor, as including a

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substantially horizontal cylindrical vessel, an inlet for the low molecular weight polyester from the second reactor disposed at one end of the vessel, an outlet for the high molecular weight polyester disposed at another end of the vessel, and a stirring rotor which is provided and rotated in the vessel to stir the second product fed to the third reactor, this stirring rotor being further defined.

Claims 17 and 31, dependent respectively on claim 16 and 30, recite that a film of the low molecular weight polyester is formed over the hollow (of the stirring rotor) by low molecular weight polyester being scooped up by the scraping vanes and flowing downward as the stirring rotor rotates. The remaining claims further define various aspects of the stirring rotor, including number of scraping vanes in a high viscosity side of the stirring blocks of the stirring rotor, where the outlet is nearer, relative to that in a low viscosity side of the stirring blocks, where the inlet is nearer; areas of the hollow of the disk in high and low viscosity sides of the stirring blocks, number of scraping vanes in high and low viscosity sides of the stirring blocks, and spaces between the disks in high and low viscosity sides of the stirring blocks. In the various claims, the high and low viscosity sides are respectively defined as sides where the outlet of the reactor is nearer, and where the inlet of the reactor is nearer.

Objections to claims 1 and 12 as set forth in Item 3 on page 2 of the Office Action mailed December 1, 2005, are moot, in view of canceling of these claims.

The rejection of claims 12-15 under the second paragraph of 35 USC 112, as set forth in Item 4 on pages 2 and 3 of the Office Action mailed December 1, 2005, is noted. In the present claims, Applicants consistently recite the raw materials of an aromatic dicarboxylic acid or its derivative and glycols, have respectively referred to products formed in the various reactors, and recite "another" end of the third reactor;

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accordingly, it is respectfully submitted that bases for rejection of claims under the second paragraph of 35 USC 112, set forth in the first paragraph on page 3 of the Office Action mailed December 1, 2005, is moot.

Moreover, Applicants have defined the low and high viscosity sides of the reactor, relative to the inlet and the outlet of the third reactor; accordingly, it is respectfully submitted that the present claims define the relationship between low viscosity side and other elements of the apparatus, and the high viscosity side and other elements of the apparatus.

As can be seen in the foregoing, it is respectfully submitted that the claims as presently submitted are free of the bases for rejection of claims under the second paragraph of 35 USC 112, as set forth in item 4 on pages 2 and 3 of the Office Action mailed December 1, 2005; however, if any indefiniteness issues remain, the Examiner is respectfully requested to contact the undersigned, so as to overcome any remaining indefiniteness issues.

Applicants respectfully submit that all of the claims now presented for consideration by the Examiner patentably distinguish over the teachings of the prior art as applied by the Examiner in rejecting claims in the Office Action mailed December 1, 2005, that is, the teachings of the U.S. patents to Ryder, No. 2,869,838, to Takiguchi, et al., No. 3,630,688, to van Endert, et al., No. 5,779,986, to Hohlbaum, No. 4,244,923, and to Rothert, et al., No. 3,761,059, under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such polyester manufacturing apparatus as in the present claims, having, inter alia, the third reactor producing a high molecular weight polyester, the third reactor including a substantially horizontal

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cylindrical vessel and, inter alia, a stirring rotor provided and rotated in the vessel to stir second feed product (low molecular weight polyester), with the stirring rotor including a plurality of stirring blocks depending on viscosities of the low molecular weight polyester polycondensed in the third reactor, and having no shaft at the rotating center, each of the stirring blocks having a plurality of disks next to each other and connected to each other by rods in parallel to the rotating center, with a hollow disposed at its center area and scraping vanes disposed on its periphery portion around the hollow in the space between the disks, the plurality of disks having a plate portion at least in its periphery portion and the stirring blocks having different structures of the disks or the vanes. See claim 16; note also claim 30.

Additionally, it is respectfully submitted that these references would have neither disclosed nor would have suggested such apparatus as in the present claims, having the third reactor with the stirring rotor as discussed previously, and wherein the apparatus additionally includes first and second reactors, in which respectively an aromatic dicarboxylic acid or its derivative reacts with glycols, producing a first product, and in which the first product from the first reactor polycondenses, thereby providing a low molecular weight polyester which is further polycondensed in the third reactor. See claim 16.

Moreover, it is respectfully submitted that these applied references would have neither taught nor would have suggested such apparatus, as in the present claims, having features as discussed previously, and, additionally, wherein the stirring rotor is provided such that a film of the low molecular weight polyester is formed over the hollow by low molecular weight polyester being scooped up by the scraping vanes and flowing downward as the stirring rotor rotates. See claims 17 and 31.

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Furthermore, it is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such apparatus as in the present claims, having features as discussed previously, and, moreover, variously wherein the number of scraping vanes in a high viscosity side of the stirring blocks, where the outlet is nearer, is smaller than the number of scraping vanes in a low viscosity side of the stirring blocks, where the inlet is nearer; and/or wherein an area of the hollow in a high viscosity side of the stirring blocks, where the outlet is nearer, is larger than the area of the hollow in a small viscosity side of the stirring blocks, where the inlet is nearer; and/or wherein a number of the scraping vanes in a high viscosity side of the stirring blocks, where the outlet is nearer, is smaller than the number of scraping vanes in a low viscosity side of the scraping blocks, where the inlet is nearer; and/or wherein the space between the disks in a high viscosity side of the stirring blocks, where the outlet is nearer, is larger than the space between the disks in a low viscosity side of the stirring blocks, where the inlet is nearer.

The invention as claimed in the above-identified application is directed to apparatus for producing a high molecular weight polyester from raw materials of an aromatic dicarboxylic acid or its derivative and glycols. According to the present invention, raw materials are supplied to a first reactor, and a reaction product formed therein is passed to a second reactor wherein polycondensation occurs to form a low molecular weight polyester, and the resulting product therefrom is passed to a third reactor in which further polycondensation occurs in order to manufacture the high molecular weight polyester. The third reactor comprises a substantially horizontal cylindrical vessel, in which a stirring rotor is provided.

As a feature of the present invention, the stirring rotor includes a plurality of

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stirring blocks dependent on viscosity of the low molecular weight polyester polycondensed therein and having no shaft at the rotating center, each of the stirring blocks having a plurality of disks next to each other and connected to each other by rods in parallel to the rotating center, with a hollow disposed at the center area of each disk and scraping vanes disposed on its periphery portion around the hollow in the space between the disks, the plurality of disks having a plate portion at least in its periphery portion and the stirring blocks having different structures of the disks or vanes. By this feature, there can be obtained advantageous effects that a polyester can be manufactured with less energy, and improved efficiency.

In the present invention, a plate portion is provided in a periphery portion of the disk, to prevent materials having low polymerization degree (that is, low viscosity) from moving toward the outlet side from the reactor, materials between the disks being scooped up by the scraping vanes and then flowing downward with rotation of the disks. The material flowing downward becomes a thin film and hangs over the hollow portions of the disks, so that a surface area of the material at the center of the disks becomes large, thereby accelerating the polymerization reaction. Thus, the disks themselves prevent undesirable movement of materials, by blocking movement of the materials along the direction of the axis of the reactor, and the scraping vanes scoop up the material between the disks, causing the material to hang over the hollow portions, and stir the materials sufficiently to accelerate the reaction of the materials between the disks, and prevent unevenness of polymerization. As will be discussed infra, it is respectfully submitted that various of the references, having a mesh disk structure, would not block disadvantageous flow of low viscosity (low polymerization degree) material along the axis of the reactor, toward the reactor outlet; and without the scraping vanes would not achieved the

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desired flow, including the thin film flowing to the hollow disposed at the center area of the disks.

It is emphasized that through the stirring rotor according to the present invention, having the disks having the plate portion and the hollow, and also having the stirring vanes, and also wherein the disks are connected to each other by rods in parallel to the rotating center the flow of material in a thin film is effectuated to improve the polymerization reaction, while the plates block undesirable movement of material, whereby both effective and efficient polymerization is achieved while preventing unevenness of the polymerization.

Rothert, et al. discloses an apparatus and method for carrying out mixing, reacting and propelling of flowable materials. The apparatus includes a rotary carrier in the form of a cage having a row of substantially planar discoidal propulsion members mounted thereon to rotate therewith, the centers of the discoidal members being substantially at the axis of rotation of the carrier so that each discoidal member symmetrically surrounds that axis. Each of the discoidal members is inclined somewhat away from being normal or perpendicular in relation to the axis of rotation, so that one point, hereinafter designated the "trailing point" of the periphery of that member, is closer to the intake end of the apparatus than any other point. The trailing points of the successive members are disposed along a line which is generally helicoidal, with the axis of the helicoidal line being substantially coaxial with the axis of rotation of the carrier. Note the paragraph bridging columns 1 and 2 of this patent. This patent discloses that the discoidal members are annular discs, having a continuous and unobstructed central opening. See column 2, lines 20-29. Note also column 2, lines 48-50 and 55-58. This patent discloses, as an especially advantageous embodiment, use of a screw-shaped stripper provided bearing

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against a fixed opposing surface on the end wall on the outlet side of the reactor housing, this stripper continuously removing material which has been forwarded to the outlet end from the end wall opposing surface, the last annular disc in this embodiment being preferably provided as the only annular disc which lacks a tilt, thus being perpendicular to the rotational axis. Note column 3, lines 29-39. See also column 3, lines 53-57. Note further column 3, lines 41-51; column 5, lines 19-28; and the paragraph bridging columns 6 and 7.

Hohlbaum discloses apparatus for contacting materials, and is particularly concerned with a slurry/liquid contactor. See column 1, lines 5-10. The apparatus includes a drum having disks so as to divide the drum into compartments in the drum interior, with annular passages for movement of phases of the treated material from compartment to compartment. The structure includes at least one blade which is carried by the rotor, which penetrates into the annular passages and which is operable to maintain the passages at least partly clear of stationary solids. This patent discloses that the blade may be in the form of a plough extending from the discs and into the annular passage. Note the paragraph bridging columns 1 and 2 of this patent. See also column 2, lines 61-64; column 3, lines 27-29; and column 4, lines 3-10.

It is noted that the Examiner did not apply the combined teachings of Rothert, et al. and Hohlbaum against the subject matter of previously considered claims 12 – 15, only applying the teachings of these references against claims 1, 2 and 7. See Item 8 on pages 8-11 of the Office Action mailed December 1, 2005. Note that previously considered claim 12 recited that the stirring rotor included a plurality of stirring blocks provided with stirring vanes having no shaft at a rotating center, the stirring blocks having the stirring vanes being different in structure from one another.

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Note corresponding recitations in present claims 16 and 30. It is respectfully submitted that Rothert, et al. and Hohlbaum would have neither taught nor would have suggested the subject matter of present claims 16-37, for at least the same reasons that previously considered claims 12-15 patentably distinguished over the teachings of Rothert, et al. and of Hohlbaum, and for additional reasons of the additional structure of the stirring rotor as in claims 16 and 30.

Ryder discloses structure for agitation of liquids, particularly in connection with mixing of material undergoing polymerization to a highly viscous condition. The structure includes, inter alia, a multiplicity of screens adapted to rotate and thereby agitate liquid in the vessel, the screens nearest the inlet end of the vessel being arranged in pairs and located with the spacing between the screens of any pair exceeded by the spacing between either screen of the pair and the nearest screen outside the pair. See column 1, line 65 to column 2, line 3. Note also column 2, lines 3-11, 21-33 and 45-49. Note also column 3, lines 9-16 and 68-71.

Takiguchi, et al. discloses apparatus for producing polymer having a high degree of polymerization by continuously performing polymerization reaction while removing by-produced material having a low molecular weight. The apparatus includes a substantially cylindrical reactor vessel of circular or oval cross section having a central axis disposed in a substantially horizontal plane, the vessel including, inter alia, an agitator rotatably mounted in the reactor vessel, the agitator being defined, for example, at column 2, lines 26-40. This patent discloses at column 3, lines 15-27, that the plurality of agitating members 14 of the agitator are made of frustoconical wire gauze, grid or the like with its base having a diameter slightly smaller than the inside diameter of the reactor.

In each of Ryder and Takiguchi, et al., the disk members are of a mesh-type

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structure. It is respectfully submitted that such disclosure of mesh structure would have neither taught nor would have suggested the plate structure, with a hollow disposed at its center area, for the plurality of disks, as in the present claims, and/or the scraping vanes disposed on the periphery portion of the disks around the hollow in the space between these disks, and advantages thereof as discussed in the foregoing, including blocking of flow of the low-viscosity material (e.g., not sufficiently polymerized material) in the axial direction, while providing a desired thin film of the material for efficient and effective further polymerization.

It is respectfully submitted that where the disks are made of mesh, quality of the product obtained by the apparatus cannot be made sufficiently uniform, due to, for example, axial flow of low-viscosity material. As a result, the size of the reactor has to be large, costs for production or operation become high, and efficiency for obtaining product is low.

Moreover, in each of Ryder, et al. and Takiguchi, et al., a large amount of material having a low polymerization degree and low viscosity would exist at the outlet side, so that the products obtained from the outlet have large non-uniformity in polymerization degree, and a uniformity of properties is unsatisfactory. While the number of disks may be increased in order to attempt to obtain sufficient stirring of materials, as indicated previously the size of the reaction vessel becomes large and operation costs become high, because more energy is necessary to rotate the increased number of disks. Such problems are avoided according to the present invention, having the scraping vanes and plates with the hollow disposed at its center area, and with the rods in parallel to the rotating center connecting disks next to each other; and, moreover, wherein a film of the low molecular weight polyester is formed over the hollow by the low molecular weight polyester being scooped up by

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the scraping vanes and flowing downward as the stirring rotor rotates.

Van Endert, et al. discloses a reactor device for free-flowing and higher-viscosity media, utilizing a rotor which is in the form of a hollow cylinder connected to stub shafts and provided with openings, and upon which annular members are attached transversely to the longitudinal axis of the reactor casing, so that stability is increased and duration time of the medium may be meaningfully controlled by corresponding design and number of the annular members. See column 1, lines 47-59.

This patent document requires a hollow cylinder provided with openings to provide a high degree of resistance to bending. Note also column 2, lines 45-56. See also column 2, lines 57-61, disclosing that in the higher-viscosity region, stripper rods are disposed between the annular members in the sump of the medium, by means of which bridging formation between the disks and excessive oblique positions of the level are avoided. Note also the paragraph bridging columns 3 and 4, of this patent.

It is emphasized that van Endert, et al. requires a hollow cylinder provided with openings. It is respectfully submitted that upon rotation of the rotor in Van Endert, et al., materials would hang over the mesh or grid of the hollow cylinder in the form of a string or film, and would tend to adhere to the hollow cylinder and rotate together therewith. Especially in blocks near the outlet side where the materials have high viscosity, the materials adhering to the mesh or grid of the hollow cylinder would cause a polymerization reaction without being properly stirred. Moreover, as discussed infra, the material would primarily stay outside the hollow cylinder. As a result, the quality of the products obtained from the outlet of the reaction vessel is deteriorated.

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In contrast, according to the present invention, a hollow is disposed at the center area of the disks, with scraping vanes disposed on periphery portions of the disks around the hollow in the space between these disks; that is, the cylinder with openings as in van Endert, et al. is absent. Moreover, according to the present invention, the plurality of disks are connected to each other by rods in parallel to the rotating center, and wherein a hollow is disposed at a center area and scraping vanes are disposed on the periphery portion around the hollow in the space between the disks. According to the present invention, the rods which connect the disks are positioned in periphery portions around the center hollow so as to prevent the material from rotating together with the disks owing to adhesion of the materials to the disks. Moreover, the scraping vanes scoop up the material and the material flows down to renew the surface of the materials so that stirring of the materials between the disks, and polymerization reaction of material, are uniformly effected. Thus, according to the present invention, the central area (the hollow) is efficiently utilized for obtaining the product of high quality, in contrast to van Endert, et al.

As described in column 4, line 67 to column 5, line 3, of van Endert, et al., the external diameter of the hollow cylinder terminates in the lower area of the reactor slightly above the filling level of material. Thus, stirring and reaction are effected outside of the hollow cylinder in Van Endert, et al. Clearly, the structure as in van Endert, et al., including the hollow cylinder, would have taught away from the present invention, including the hollow, scraping vanes and rods, and advantages achieved thereby.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

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